What Makes a Project Successful?

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Abstract

As more stream restoration projects are being funded, designed, and built, questions arise with increasing frequency as to whether funds have been spent effectively and if water quality improvements, channel stability, and enhanced ecological function are indeed the result of stream restoration efforts. What makes a project successful? Is a project with multiple goals successful even if not all goals are met? What constitutes a good design? What constitutes project failure? How much risk is acceptable? Stream restoration professionals are striving to answer these questions. This paper presents observations to stimulate discussion regarding some critical factors, such as clearly defined goals and success criteria, communication and teamwork, funding, assessment and design, construction, and post-construction monitoring and maintenance that can affect the success of a project.

Introduction

River restoration projects often have multiple goals. Common goals for river restoration projects are to return disturbed systems to geomorphically and hydraulically stable states and to restore ecological function. Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (SER Primer, 2002). Many restoration projects attempt to return ecosystems to their historic functions. However, most impacted urban streams will not completely recover these functions due to current site constraints and altered watershed conditions. Therefore, the design goals must be adjusted to accommodate current and future site and watershed constraints.

Successful restoration projects require expertise in hydrology, hydraulics, sediment transport, fluvial geomorphology, water quality, biology, and ecology. As such, project teams, including biologists, engineers, hydrologists, watershed managers, and local resource agencies work together to achieve goals set forth in the Clean Water Act. In addition to technical expertise, successful river restoration projects also require sponsors to consider social and political aspects including local demographics, recreation, economics, and culture. The best projects address channel stability, wildlife habitat, water quality improvement, and community priorities. In order to produce a successful project, teams must work together, have clear goals and success criteria, appropriate funding, a well-conceived design with clearly stated assumptions, quality control, construction experience and flexibility, and effective monitoring.

In addition to goals for individual projects, it is important to note that multiple projects done in targeted watersheds stand a better chance of water quality and ecological improvements due to cumulative impacts than projects done in piecemeal fashion. Within targeted watersheds, identified by conducting watershed assessments as mandated by the President's Clean Water Action Plan in 1998, a watershed plan must have broad consensus in order to be implemented. The list of stakeholders could be short or long depending on the location and size of the project and its watershed, but might include landowners, municipal governments, policy makers, permitting agencies, resource and wildlife agencies, special interest groups, land developers, planners, engineers, and researchers.

All stakeholders must be involved early and allowed meaningful input to the plan. Ultimately, a group of stakeholders can evolve into a more permanent watershed management structure, such as a watershed coalition, that can provide the long-term commitment and resources necessary for implementation (Caraco et al., 2001.) Cooperation, trust and mutual respect should exist among the stakeholders. In short, stakeholders should feel a sense of pride in and ownership of the results.

Clearly defined goals, objectives, and success criteria

The initial step in any restoration project is to determine the goals and objectives of the project. Typical restoration project goals include channel stability, water quality improvement, habitat enhancement, increased biodiversity, fishery enhancement, riparian corridor reforestation, improved aesthetics, and increased recreational opportunities. In determining the project goals, input from all concerned stakeholders should be considered. An effective method to facilitate input from all stakeholders is a meeting hosted by a local watershed council or stream organization. Questions addressed at this meeting might include:

"What are the desired attributes of the watershed or sub-basin?"
"Can the goals be achieved in a cost-effective manner?"
"What are the observed problems in this watershed?"
"What are the perceived causes and consequences of those problems?"
"What would you define as a successful project?"
"What would constitute failure?"
"How much risk is acceptable?"
"How does this project support the overall plan for the watershed?"
"How will projects be prioritized?"
"Is this project compatible with other planned activities in the area?"
"What concessions and/or compromises are you willing to make to see this project to fruition?"

In conjunction with determining the goals of the project, a complete analysis of the existing system is required including geomorphic, hydrologic, and ecological assessments. Project goals may need to be revised after pre-construction monitoring and assessment of the stream system. It is only after assessment that the potential for restoration success might be determined or all project constraints identified. In fact,

project goals could be modified several times during the planning phase of the project in reaction to needs of the community and the physical, economic, and political constraints on the design.

The project objectives should support the project goals and give direction to the overall design and implementation of the restoration effort. For example, one project goal might be to improve water quality and the associated project objective could be to intercept illegal discharges along a river reach. The project objectives will provide a basis for determining project success through post construction monitoring, so it is important they are clearly defined and quantifiable. If they are too vague or not measurable, it will be impossible to determine the short and long term success of the project.

Clearly defined goals and objectives also help convey the desired project outcome to all stakeholders. If project goals and objectives are too vague or unrealistic, then the project may never live up to stakeholders' expectations. If a project goal is simply to improve fish habitat, with no associated objectives, then the interpretation of that goal is left to each individual stakeholder. For example, one group might believe they are working to create a trout stream with a "six catch limit" while a another might be working toward a 10% increase in overall trout biomass. Of additional concern would be the group who has a totally different target species in mind when working towards "improving fish habitat." While this example might seem excessive, it should convey the potential problems associated with poorly defined goals, objectives, and success criteria.

Communication and teamwork

Clear and frequent communication among stakeholders facilitates all stages of planning, assessment, design, permitting, and construction. One problem that exists is caused by what can be called professional myopia. Some stream professionals have narrow views biased in favor of their area of expertise. To overcome this, a design team with skills in engineering hydrology and hydraulics, sediment transport, ecology, biology, and geomorphology can be created. The variety of contributors on the design team helps to avoid the pitfall of preconceived technical notions. This also ensures that the solution fits the problem and does not force a problem to fit a solution.

A design team often is contracted by an agency or organization representing a landowner or group of landowners. Once a conceptual design is developed, it is important that the project manager arrange a meeting between the design team and the landowner(s) so the design concept can be reviewed and approved before proceeding with permitting. This allows identification of and agreement upon the location of the designed channel, access points, planned crossings, tree preservation, easement boundaries, and other issues to be accounted for in the final design. This meeting builds trust, creates a sense of project ownership by providing an opportunity to exchange ideas, and provides the landowner an understanding of how the desired results can be achieved and how the design may impact their land use.

By expanding the concept of team to include all regulating agencies that comment on or issue permits for river restoration projects, additional conflict may be avoided. For instance, during permit review, the design firm is in communication with multiple regulating agencies, but those agencies are often not in communication with each other. If this process was changed, and a regulatory technical review committee with representatives from each agency was formed, then regulators and designers could discuss and expeditiously resolve all permit requirements and regulatory concerns. This forum would help everyone understand not only the multiple goals of the project but also the tradeoffs that may be required to optimize those goals. In the case of a conflict, permit requirement priority would go to the agency that has the highest jurisdictional authority. It is important that everyone recognizes that long-term benefits may need to take priority over short-term impacts caused by construction.

Project Funding

Projects that begin with a strong and broad coalition are more capable of identifying restoration opportunities and can provide support for funding, land acquisition, and regulatory permitting to help insure a successful restoration project. Identifying potential funding sources is an early, critical step in any restoration project initiative. There are many potential sources for funding including local, state, and federal government agencies. Funding could also come from philanthropic foundations, landowner associations, non-profit special interest groups such as watershed councils, and private individuals. In some cases, private funds are raised to prepare master plans for grant applications and project cost estimates in an effort to secure additional funding. The private funds can also be used as matching contributions required by some grant agencies.

While appropriate funding is required for every project, funding can ensure success of a project when the funds connect the restoration goals and objectives of a project to missions of funding agencies. For example, an organization's mission might be to reduce sediment loads in the Great Lakes Basin. If a restoration project is located in Michigan and will address bed and bank erosion, this might be a good organization to approach for funding. Other funding organizations might place conditions on what their funds can be allocated for. For example, they may only fund construction activities and funding for design will have to come from another source. Another condition of funding might be public education. Therefore, project goals might be adjusted to include outreach and education activities. Since funding can serve as a major constraint to a restoration project, it is common to adjust project goals and scope according to potential or obtained funding sources.

It is important to recognize that project funding does not exclusively mean cash. In-kind services (donated time) can play a major role in many restoration projects. Local professionals might be willing to donate their time and technical expertise towards project design. Government organizations are frequently in a position to donate resources to a project. Local citizen groups can be organized to perform a portion of the labor such as planting. Educational institutions may allocate resources

in exchange for their ability to test the applications of a new structure or technique or measure the effectiveness of an experimental treatment.

Often large entities such as state highway departments or companies doing large developments will have mitigation requirements to compensate for impacts of their projects. They typically look for mitigation opportunities within the watersheds of their impacts. A watershed restoration action strategy detailing what kind of restoration work is needed in a watershed can lead to funding for restoration projects by those seeking mitigation opportunities.

Once project funds are secured, they cannot always support initial project goals. In this case, project scope may be reduced, but stakeholders' expectations often remain high. Insufficient funds and unrealistic expectations may lead to significantly increased risk.

Areas where allocated funds may come up short are reimbursing up-front costs related to landowner negotiations, legal issues, and grant writing; revegetating a disturbed site; and post-construction monitoring/maintenance. For instance, revegetation plans for river restoration projects often specify seed, live stakes and bare root plants which will need to grow for thirty to forty years before providing some of their intended benefits. In urban areas in particular, invasive species often take advantage of disturbed soils and then compete with planted, native species for nutrients, light, and rooting space (Ruiz, 2003). Long-term success may depend on planning and funding for ongoing, invasive exotic management until native vegetation can out compete undesirable species. Finally, post-construction monitoring and maintenance are often underfunded. The data gained from monitoring can teach designers about what works and what does not work in what conditions, which may lead to future design improvements and decreased risk.

QA/QC

When time, materials, and funds are invested in a project, the results should be as reliable and timely as possible. As such, a quality assurance and quality control (QA/QC) provision becomes critical, especially as the number of designers, planners, contractors, and volunteers involved in a project grows. The assessment and design should be reviewed for compliance with standard engineering and professional practices, adequacy of scope, appropriateness of data used, consistency, accuracy, comprehensiveness, and reasonableness of results. (Copeland et al., 2001) An independent, critical review of the assessment and design performed by a multidisciplinary team can help ensure a successful project. The QA/QC plan may also include a provision for adaptive management as site conditions change through time.

Design and Construction Considerations

The keys to successful design include information gathered from and influenced by historic context; topography, geology and soils; hydrology and hydraulics; sediment

transport; ecological processes; habitat complexity, connectivity and function; and floodplain and riparian features.

Incorporating contingency planning into the design greatly minimizes potential threats to the long-term sustainability of the project. Assess potential causes of failure and design features to counteract these causes. Design in-stream structures to withstand the range of design flows, plan vegetation strategies to minimize invasive species recruitment; and provide access for monitoring, maintenance, and repair. The design should also take into account potential changes in the watershed, including increases in impervious cover, land use change, and stormwater management.

One recurring design issue is how to maintain channel flows while minimizing downstream sedimentation during construction. One approach is to pump stream flow around the work area and work "in the dry." While this approach may minimize downstream sedimentation, it eliminates the ability to see flow lines as water approaches bends and structures. The ability to make field adjustments based on flow lines may improve the long term effectiveness of the project by enhancing structures' effectiveness and minimizing potential problems such as scour. Conversely, working in the wet may be a real concern if an endangered mollusk, at risk of being smothered by sediment, lives downstream. Seek innovative solutions that take into account the project's most important long-term considerations while fitting its budget.

Creating a solid design does not guarantee success. Initiating a construction program that adheres to the plans and specifications while adapting to unforeseen field conditions will greatly increase the chances of a successful stream restoration project. Furthermore, success may be connected to the timing and severity of storm events during construction. The construction schedule is also influenced by season, which relates to weather patterns, fish life cycle, and planting season.

There are two forms of construction delivery for stream restoration projects, Design/Bid/Oversight (DBO) and Design/Build (DB). The DBO delivery system is typically used in most projects, where a design firm designs the project and provides construction oversight while a construction firm is selected to build the project based on competitive bid. Restoration projects often require field adjustments during construction. Having the design professional on-site for the duration of the project to address these changes improves the success of stream restoration projects. Also during construction, consistency in staff and message is important. Project leadership should be consistent. Alternating construction observers or construction foremen can lead to confusion and complications.

DB can also be a successful delivery system for stream restoration projects. DB provides an integrated process of design and construction, allowing for flexibility throughout the project. It may also save time and money.

Assuming that a project is completed to the best of its team's capabilities, there still is an element of uncertainty. To some degree, success may be dependent upon luck

during and after construction, especially related to the timing and severity of storm events and the success of revegetation. The degree of project success may depend upon the construction schedule relative to the season, which influences weather patterns, fish life cycle, and planting season.

Post-Construction Monitoring and Maintenance

Post-construction monitoring should evaluate whether or not the goals and objectives of the restoration project have been met, based on defined and quantifiable criteria determined during project planning and design. If a project is not meeting its goals, then the monitoring plan should be detailed enough to provide sufficient information to determine why it is not performing as expected and allow for adaptive management. The success of monitoring and maintenance also requires a long-term commitment and sufficient funds set aside to conduct monitoring, adapt to new conditions, and make repairs to or redesign and reconstruct features that limit achievement of project goals.

Monitoring should be conducted over a sufficient time period to ensure that goals are met on a permanent basis, preferably a period of five to ten years or more. Stability monitoring should be conducted long enough so that the restored stream reach is tested by several flows at or above bankfull discharge. Often overlooked is the need to monitor project effectiveness during high flows that occur shortly after construction is complete but before stabilizing vegetation has developed sufficiently. Inspection after significant runoff events in the first year of the project's completion can often indicate later whether a failure is related to the temporary lack of established vegetation on exposed areas during high flow events or inadequate long-term stability of structures.

Maintenance and monitoring are often significantly underfunded. More and better monitoring data can help reduce and/or mitigate risk inherent in stream restoration projects by providing, or lacking to provide, supporting data for design assumptions, structural effectiveness, and successful reestablishment of woody riparian vegetation. Long term monitoring can also identify recurrent problems, which may lead to a portion of a project to be deemed a failure. Understanding the cause of failure will help designers avoid those specific conditions improve chances of future success.

Summary

Success of a river restoration project relies heavily on the specific definition of success as it relates to project goals and the accuracy and extensiveness of monitoring measurements. River restoration projects are complex undertakings, with successful projects requiring a wide range of professional expertise, community support, appropriate funding, clearly defined goals and objectives with measurable success criteria, and clearly stated and reasonable design assumptions. A multidisciplinary team approach with clear and frequent communication facilitates project development and construction. Much still remains to be done to improve the success of river restoration projects in altered and degraded river systems. Some recommendations to improve project success are:

- Work in interdisciplinary teams with trained, qualified professionals;
- Involve all stakeholders early in the planning process;
- Articulate project goals and relate them to a holistic water quality improvement plan for the watershed;
- Define specific, measurable success criteria;
- Develop partnerships with funding and regulatory agencies
- Plan for flexible funding or have contingency funds available;
- Adhere to the most appropriate professional assessment and design standards;
- Provide consistent construction oversight; and
- Perform annual monitoring and provide for adaptive management.

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